U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

MISCELLANEOUS INVESTIGATIONS SERIES
MAP I–1970–C
Explanatory pamphlet accompanies map

Base from U.S. Geological Survey
International Map of the World (IMW) Series:
Lake Superior, 1966; Lake of the Woods and Winnipeg, 1967; Lake Nipigon, 1969; Des Moines, 1970; Ozark Plateau, 1971
Lambert Conformal Conic projection
Army Map Service compilations:
Dakotas, Minneapolis, and Wichita, 1955; Platte River, 1959
Modified Polyconic projection of the International Map of the World

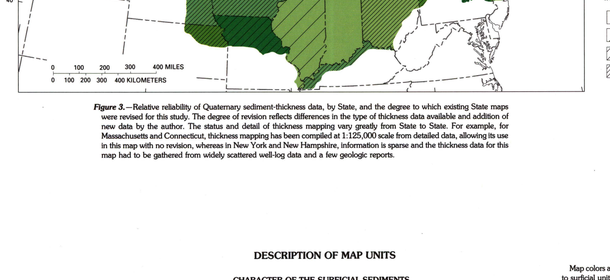


Figure 1.—Index map showing location of the four sheets in this series. Maps I–1970–A, –D, and –B are listed in the references cited as Soller (1993, 1994, and in press a), respectively. The mapped area in each sheet is colored. The base map used for each sheet consists of a band-mosaicked group of 4° × 6° quadrangles from the International Map of the World Series and Army Map Service 1:1,000,000-scale maps.

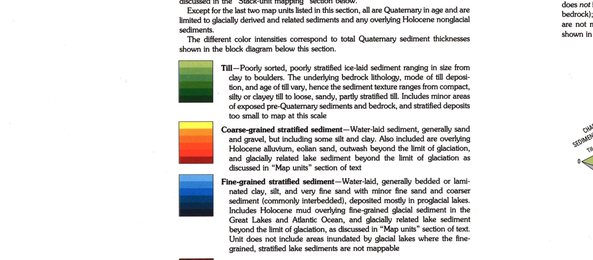


Figure 2.—Relative reliability of the surficial geologic data, by State, and the degree to which existing State surficial maps were revised for this study. The degree of revision largely reflects differences in the emphasis of available surficial mapping (for example, stratigraphy, geomorphology, or sediment type). The status and detail of surficial mapping vary greatly from State to State. For example, for Massachusetts and Connecticut, maps of surficial materials have been compiled at 1:125,000 scale from 1:24,000-scale maps, allowing use of data in this map with no revision, whereas in New York and New Hampshire, detailed surficial geologic mapping is quite sparse, and the data for this map had to be compiled from a combination of geologic reconnaissance, soils, and topographic maps.

EXPLANATION

Relative reliability of mapping

INCREASING RELIABILITY

Extent to which existing State maps were revised for this study

- Unrevised
- Slightly revised
- Substantially revised
- No available State map

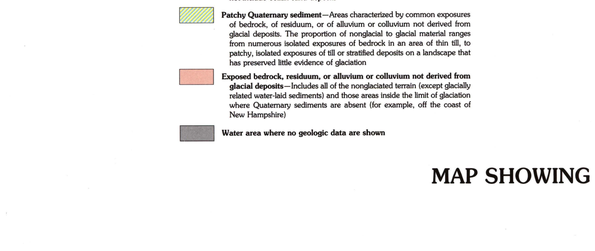


Figure 3.—Relative reliability of Quaternary sediment-thickness data, by State, and the degree to which existing State maps were revised for this study. The degree of revision reflects differences in the type of thickness data available and addition of new data by the author. The status and detail of thickness mapping vary greatly from State to State. For example, for Massachusetts and Connecticut, thickness mapping has been compiled at 1:125,000 scale from detailed data, allowing its use in this map with no revision, whereas in New York and New Hampshire, information is sparse and the thickness data for this map had to be gathered from widely scattered well-log data and a few geologic reports.

EXPLANATION

Relative reliability of mapping

INCREASING RELIABILITY

Extent to which existing State maps were revised for this study

- Unrevised
- Slightly revised
- Substantially revised
- No available State map

DESCRIPTION OF MAP UNITS

CHARACTER OF THE SURFICIAL SEDIMENTS

These map units depict the distribution of sediment textures at the land surface. Sediments at the land surface do not necessarily extend to bedrock. Information on subsurface textures is sparse, and, where available, is represented by color patterns, as discussed in the "Stack-unit mapping" section below.

Except for the last two map units listed in this section, all are Quaternary in age and are limited to glacially derived and related sediments and any overlying Holocene nonglacial sediments.

The different color intensities correspond to total Quaternary sediment thicknesses shown in the block diagram below this section.

Till—Poorly sorted, poorly stratified ice-laid sediment ranging in size from clay to boulders. The underlying bedrock lithology, mode of till deposition, and age of till vary, hence the sediment texture ranges from compact, silty or clayey till to loose, sandy, partly stratified till. Includes minor areas of exposed pre-Quaternary sediments and bedrock, and stratified deposits too small to map at this scale

Coarse-grained stratified sediment—Water-laid sediment, generally sand and gravel, but including some silt and clay. Also included are overlying Holocene alluvium, eolian sand, outwash beyond the limit of glaciation, and glacially related lake sediment beyond the limit of glaciation as discussed in "Map units" section of text

Fine-grained stratified sediment—Water-laid, generally bedded or laminated clay, silt, and very fine sand with minor fine sand and coarser sediment (commonly interbedded), deposited mostly in proglacial lakes. Includes Holocene mud overlying fine-grained glacial sediment in the Great Lakes and Atlantic Ocean, and glacially related lake sediment beyond the limit of glaciation, as discussed in "Map units" section of text. Unit does not include areas inundated by glacial lakes where the fine-grained, stratified lake sediments are not mappable

Organic-rich sediment—Peat, swamp, and marsh deposits

Loess—Windblown deposits of silt with lesser sand that cover extensive upland areas in the central United States. Mapped only where thicker than 20 ft, and shown only as a veneer to avoid undue emphasis. Does not include eolian sand deposits

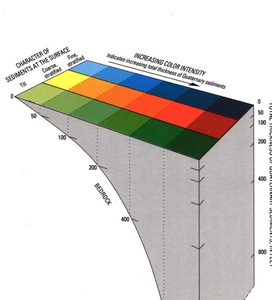
Patchy Quaternary sediment—Areas characterized by common exposures of bedrock, of residuum, or of alluvium or colluvium not derived from glacial deposits. The proportion of nonglacial to glacial material ranges from numerous isolated exposures of bedrock in an area of thin till, to patchy, isolated exposures of till or stratified deposits on a landscape that has preserved little evidence of glaciation

Exposed bedrock, residuum, or alluvium or colluvium not derived from glacial deposits—Includes all of the nonglaciated terrain (except glacially related water-laid sediments) and those areas inside the limit of glaciation where Quaternary sediments are absent (for example, off the coast of New Hampshire)

Water area where no geologic data are shown

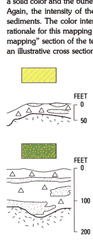
THICKNESS OF QUATERNARY SEDIMENTS

Map colors are assigned on the basis of the surficial geologic unit; exceptions are limited to surficial units that form a veneer (see "Stack-unit mapping" section below). The *total thickness* of Quaternary sediments is shown by the intensity of those colors. For example, a shade of light green on the map corresponds to an area of thin Quaternary sediments, with till as the surficial unit. Darker green also indicates till (of unspecified thickness) at the surface, but in an area of thicker Quaternary sediments. Till, or any other surficial unit, does not implicitly extend uninterrupted to the base of the Quaternary section (that is, to bedrock); the specific variations in sediment character with depth may not be known or are not mappable. Color intensities that correspond to total-sediment thicknesses are shown in the block diagram below.



STACK-UNIT MAPPING

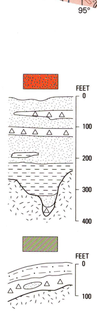
Where appropriate, a simplified portrayal of the vertical succession of units is shown by a two-unit stack. These two-unit stacks convey general information on the occurrence of buried units, and should not be used to infer a vertical lithologic succession. Two general types are used here. First, where a patchy veneer of sediment occurs, the directly underlying lithology is shown as the solid map color, and the thin overlying unit appears as a pattern of diagonal stripes whose color reflects that unit's lithology. The intensity of the solid map color indicates the total thickness of Quaternary sediments. Second, where the surficial unit is continuous and the geometry of the buried unit (for example, stratified sand and gravel filling a buried valley) is fairly well known, the surficial unit is shown in a solid color and the buried unit is represented by a dot pattern of the appropriate color. Again, the intensity of the solid map color indicates the total thickness of Quaternary sediments. The color intensity of the stripes and dots does not indicate thickness. The rationale for this mapping technique and its limitations are discussed in the "Subsurface mapping" section of the text. Five examples, each including map view, description, and an illustrative cross section, are given below.



A thin and in places discontinuous veneer of coarse-grained stratified sediment is directly underlain by till. Variations in sediment character with depth are not known or not mappable, and till is not implied to extend without interruption to the base of the Quaternary section (that is, to bedrock). The total thickness of Quaternary sediments is less than 50 ft

Till occurs at the surface and is thought to constitute a large part of the total sediment thickness. Coarse-grained stratified sediment of unspecified thickness, depth, and continuity occurs within the section. Variations in sediment character may occur throughout the section (for example, subordinate stratified sediment may be interbedded with the dominant till, and some till or fine-grained stratified sediment may be interbedded with the coarse-grained stratified unit). The total thickness of Quaternary sediments is between 100 and 200 ft

A thin and in places discontinuous veneer of organic-rich sediment is directly underlain by fine-grained stratified sediment. Variations in sediment character with depth are not known or not mappable, and fine-grained stratified sediment is not implied to extend without interruption to the base of the Quaternary section (that is, to bedrock). The total thickness of Quaternary sediments is between 50 and 100 ft



Coarse-grained stratified sediment occurs at the surface, and is thought to constitute a large part of the total sediment thickness. Fine-grained stratified sediment of unspecified thickness, depth, and continuity occurs within the section. Variations in sediment character may occur throughout the section (for example, subordinate till or fine-grained stratified sediment may be interbedded with the dominant coarse-grained stratified unit, and some coarse-grained stratified sediment or till may be interbedded with the fine-grained stratified unit). The total thickness of Quaternary sediments is between 200 and 400 ft

Loess greater than 20 ft thick occurs at the surface, and is directly underlain by till. Variations in sediment character with depth are not known or not mappable, and till is not implied to extend without interruption to the base of the Quaternary section (that is, to bedrock). The total thickness of Quaternary sediments is between 50 and 100 ft

Lithologic Patterns Used Above

- Till
- Coarse-grained stratified sediment
- Fine-grained stratified sediment
- Organic-rich sediment
- Bedrock
- Loess

EXPLANATION OF MAP SYMBOLS

- **Contact between sediment units at the land surface**—Absence of contact between coarse-grained stratified sediment and exposed bedrock indicates arbitrary limit of mapping
- **Maximum extent of ice during late Wisconsinan (Woodfordian) time**—Position of line is uncertain in places, especially in parts of Montana and North Dakota
- **Maximum extent of ice prior to late Wisconsinan time**—Age of deposits along this boundary is variable. In many places, boundary is defined by presence of glacial erratics, because till is absent
- **Drumlins and other streamlined, elliptical landforms shaped by moving ice**
- ND-4 **Location of selected lithologic logs shown in figure 5 (in pamphlet)**—Logs illustrate subsurface lithologic variations that can be expected in different geologic settings

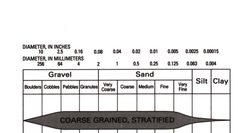


Figure 4.—Range of particle sizes in the mapped surficial units (adapted from Stone and others, 1979, figs. 2, 3).

Thickness intervals	Feet	Meters
	0 – 50	0 – 15
	50 – 100	15 – 30
	100 – 200	30 – 61
	200 – 400	61 – 122
	400 – 800	122 – 244
	>800	>244

U.S. Customary units (feet) and metric equivalents for the mapped sediment thickness intervals. To obtain meters, multiply feet by 0.3048

MAP SHOWING THE THICKNESS AND CHARACTER OF QUATERNARY SEDIMENTS IN THE GLACIATED UNITED STATES EAST OF THE ROCKY MOUNTAINS

NORTHERN AND CENTRAL PLAINS STATES (90° TO 102° WEST LONGITUDE)

By
David R. Soller

1997

SCALE 1:1 000 000

TOPOGRAPHIC CONTOUR INTERVALS: NORTH OF 48° LAT., 100 METERS;
BETWEEN 44° AND 48° LAT., 150 METERS, EXCEPT 100 METERS EAST OF 90° LONG.;
SOUTH OF 44° LAT. AND WEST OF 96° LONG., 150 METERS;
SOUTH OF 44° LAT. AND EAST OF 96° LONG., 100 METERS

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